

Appl. No.: 10/616,861
Amdt. Dated: 01/08/2007
Off. Act. Dated: 12/11/2006

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (original): An underground utility locating and marking apparatus, comprising:
a support structure configured to maneuver along a proximate path of an underground utility; and
means carried by said support structure for locating and marking a proximate vertical position of said underground utility.

2. (original): An underground utility locating and marking apparatus, comprising:
a support structure configured to maneuver along a proximate path of an underground utility;
means carried by said support structure for locating a proximate vertical position of said underground utility; and
means carried by said support structure for marking the located position of said underground utility.

3. (original): An apparatus as recited in claim 2, wherein said means for marking the located position of said underground utility comprises a paint sprayer.

4. (withdrawn): An apparatus as recited in claim 2, wherein said means for marking the located position of said underground utility comprises a spike driver.

5. (original): An apparatus as recited in claim 2, wherein said means for locating a proximate vertical position of said underground utility comprises:

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a detector that produces a positional signal indicative of the position an underground utility; and

a controller that positions said means for marking the located position of said underground utility at a position proximate said underground utility in response to said positional signal.

6. (original): An apparatus as recited in claim 2, wherein said means for locating a proximate vertical position of said underground utility comprises:

detector means for producing a positional signal relative to a proximate vertical position of an underground utility; and

position indicating means for indicating proximate vertical position of an underground utility based on said positional signal.

7. (original): An apparatus as recited in claim 6, wherein said detector means comprises a detector selected from the group consisting essentially of a radio frequency detector, a ground penetrating radar detector, a sonic detector, and an electromagnetic detector.

8. (original): An apparatus as recited in claim 6, wherein said means for indicating a proximate vertical position of said underground utility comprises:

a carriage coupled to said support structure;

said carriage configured to move horizontally and laterally to the direction of movement of said support structure and indicate a surface position for marking;

a controller configured to receive positional signals from said detector means and generate control signals; and

a carriage actuator cooperating with said support structure and with said carriage to position said carriage at a vertical position of an underground utility in response to control signals from said controller.

9. (original): An apparatus as recited in claim 6, wherein said controller comprises a microprocessor configured to receive positional signals from said detector means and to generate control signals to said position indicating means.

10. (original): An apparatus as recited in claim 6, wherein said means for locating a proximate vertical position of said underground utility further comprises:

- an articulating arm assembly having a first end and a second end;
- said first end of said articulating arm assembly coupled to said support structure and configured to articulate said second end of said articulating arm assembly horizontally and laterally to the direction of movement of said support structure; and
- a controller configured to receive positional signals from said detector means and generate control signals;
- said second end of said articulating arm assembly configured to indicate a vertical surface position of an underground utility in response to control signals from said controller.

11. (original): An apparatus as recited in claim 6, wherein said means for locating a proximate vertical position of said underground utility further comprises:

- an articulating arm assembly having a first end and a second end;
- said first end of said articulating arm assembly coupled to said support structure and configured to articulate said second end of said articulating arm assembly horizontally;
- a controller configured to receive positional signals from said detector means and generate control signals in response; and
- an articulating arm actuator cooperating with said support structure and with said first end of said articulating arm assembly to position said second end of said articulating arm assembly at a vertical position of said underground utility in response to control signals from said controller;

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whereby said means for marking the located position of said underground utility responds to control signals from said controller by marking the located position of said underground utility.

12. (original): An apparatus as recited in claim 6, wherein said means for marking the located position of said underground utility further comprises:

a painting system support structure having a first end and a second end;
a painting system support shaft oriented horizontally and coupled to said second end of said painting support structure;
an actuator coupled to said first end of said painting system support structure and configured to position said second end of said painting system support structure in response to control signals from said controller;
a contact wheel assembly oriented vertically and coupled to said painting system support shaft and configured to rotate on said painting system support shaft;
a drum template coupled to said contact wheel assembly; and
a paint dispenser coupled to said painting system support shaft configured to dispense paint downward through said drum template;
whereby, in response to control signals from said controller, said actuator positions said second end of said painting system support structure until said contact wheel contacts a surface, said contact wheel rotates said drum template, and said paint dispenser dispenses paint through said drum template onto said surface to apply a symbol.

13. (withdrawn): An apparatus as recited in claim 6, wherein said means for marking the located position of said underground utility comprises:

a spike system support structure having a first end and a second end;

an actuator coupled to said first end of said spike system support structure and configured to position said second end of said spike system support structure in response to control signals from said controller;

a spike magazine configured to hold a plurality of spikes coupled to said spike system support structure;

a spike receiver configured to aim a spike downward and coupled to said second end of said spike system support structure and configured to receive a spike from said spike magazine; and

a spike driver coupled to said spike receiver and said spike system support structure;

whereby, in response to control signals from said controller, said support actuator positions said second end of said spike system support structure and said spike driver drives a spike downward through said spike receiver and into the ground.

14. (withdrawn): An apparatus as recited in claim 6, wherein said means for marking the located position of said underground utility comprises:

a painting system support structure having a first end and a second end;

a painting system support shaft oriented horizontally and coupled to said second end of said painting system support structure;

a painting system actuator coupled to said first end of said painting system support structure and configured to position said second end of said painting system support structure in response to control signals from said controller;

a contact wheel assembly oriented vertically and coupled to said painting system support shaft and configured to rotate on said painting system support shaft;

a drum template coupled to said contact wheel assembly;

a paint dispenser coupled to said painting system support shaft configured to dispense paint downward through said drum template;

a spike system support structure having a first end and a second end, said first end configured to align with said carriage;

a spike system support actuator coupled to said first end of said spike system support structure and configured to position said second end of said spike system support structure in response to control signals from said controller;

a spike magazine configured to hold a plurality of spikes coupled to said spike system support structure;

a spike receiver configured to aim a spike downward and coupled to said second end of said spike system support structure and configured to receive a spike from said spike magazine; and

a spike driver coupled to said spike receiver and said spike system support structure;

whereby, in response to control signals from said controller, said painting system actuator positions said second end of said painting system support structure until said contact wheel contacts a surface, said contact wheel rotates said drum template, and said paint dispense dispenses paint through said drum template onto said surface to apply a symbol; and

whereby, in response to control signals from said controller, said spike system support actuator positions said second end of said spike system support structure and said spike driver drives a spike downward through said spike receiver and into the ground.

15. (original): An underground utility locating and marking apparatus, comprising:

a support structure configured to maneuver along a proximate path of an underground utility;

a painting system coupled to said support structure;

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a detector coupled to said support structure that produces a positional signal indicative of the proximate vertical position an underground utility; and

a controller coupled to said support structure that positions said painting system at a position proximate said underground utility in response to said positional signal.

16. (original): An apparatus as recited in claim 15, wherein said detector comprises a detector selected from the group consisting essentially of a radio frequency detector, a ground penetrating radar detector, a sonic detector, and an electromagnetic detector.

17. (original): An apparatus as recited in claim 15, wherein said painting system comprises:

a painting system support structure having a first end and a second end;

a painting system support shaft oriented horizontally and coupled to said second end of said painting support structure;

an actuator coupled to said first end of said painting system support structure and configured to position said second end of said painting system support structure in response to control signals from said controller;

a contact wheel assembly oriented vertically and coupled to said painting system support shaft and configured to rotate on said painting system support shaft;

a drum template coupled to said contact wheel assembly; and

a paint dispenser coupled to said painting support shaft configured to dispense paint downward through said drum template;

whereby, in response to control signals from said controller, said actuator positions said second end of said painting system support structure until said contact wheel contacts a surface, said contact wheel rotates said drum template, and said paint dispenser dispenses paint through said drum template onto said surface to apply a symbol.

18. (original): An apparatus as recited in claim 15, further comprising:
an articulating arm assembly having a first end and a second end;
said first end of said articulating arm assembly coupled to said support structure
and configured to articulate said second end of said articulating arm assembly
horizontally;
an articulating arm actuator cooperating with said support structure and with said
first end of said articulating arm assembly to position said second end of said
articulating arm assembly at a vertical position of said underground utility in response to
control signals from said controller;
whereby said painting system responds to control signals from said controller by
marking the located position of said underground utility.

19. (withdrawn): An underground utility locating and marking apparatus,
comprising:
a support structure configured to maneuver along a proximate path of an
underground utility;
a spike driving system coupled to said support structure;
a detector coupled to said support structure that produces a positional signal
indicative of the proximate vertical position an underground utility; and
a controller coupled to said support structure that positions said spike driving
system at a position proximate said underground utility in response to said positional
signal.

20. (withdrawn): An apparatus as recited in claim 19, wherein said detector
comprises a detector selected from the group consisting essentially of a radio frequency
detector, a ground penetrating radar detector, a sonic detector, and an electromagnetic
detector.

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21. (withdrawn): An apparatus as recited in claim 19, wherein said spike driving system comprises:

a spike driving system support structure having a first end and a second end;
an actuator coupled to said first end of said spike system support structure and configured to position said second end of said spike system support structure in response to control signals from said controller;

a spike magazine configured to hold a plurality of spikes coupled to said spike system support structure;

a spike receiver configured to aim a spike downward and coupled to said second end of said spike system support structure and configured to receive a spike from said spike magazine; and

a spike driver coupled to said spike receiver and said spike system support structure;

whereby, in response to control signals from said controller, said actuator positions said second end of said spike system support structure and said spike driver drives a spike downward through said spike receiver and into the ground.

22. (withdrawn): An apparatus as recited in claim 19, further comprising:
an articulating arm assembly having a first end and a second end;
said first end of said articulating arm assembly coupled to said support structure and configured to articulate said second end of said articulating arm assembly horizontally; and

an articulating arm actuator cooperating with said support structure and with said first end of said articulating arm assembly to position said second end of said articulating arm assembly at a vertical position of said underground utility in response to control signals from said controller;

whereby said spike driving system responds to control signals from said controller by marking the located position of said underground utility.

23. (withdrawn): An underground utility locating and marking apparatus, comprising:

- a support structure configured to maneuver along a proximate path of an underground utility;
- a paint spraying system coupled to said support structure;
- a spike driving system coupled to said support structure;
- a detector coupled to said support structure that produces a positional signal indicative of the proximate vertical position an underground utility; and
- a controller coupled to said support structure that positions said paint spraying system and said spike driving system at a position proximate said underground utility in response to said positional signal.

24. (withdrawn): An apparatus as recited in claim 23, wherein said detector comprises a detector selected from the group consisting essentially of a radio frequency detector, a ground penetrating radar detector, a sonic detector, and an electromagnetic detector.

25. (withdrawn): An apparatus as recited in claim 23, wherein said paint spraying system comprises:

- a paint system support structure having a first end and a second end;
- a paint system shaft oriented horizontally and coupled to said second end of said painting support structure;
- an actuator coupled to said first end of said painting support structure and configured to position said second end of said painting support structure in response to control signals from said controller;
- a contact wheel assembly oriented vertically and coupled to said painting support shaft and configured to rotate on said painting support shaft;
- a drum template coupled to said contact wheel assembly; and

a paint dispenser coupled to said painting support shaft configured to dispense paint downward through said drum template;

whereby, in response to control signals from said controller, said actuator positions said second end of said painting system support structure until said contact wheel contacts a surface, said contact wheel rotates said drum template, and said paint dispenser dispenses paint through said drum template onto said surface to apply a symbol.

26. (withdrawn): An apparatus as recited in claim 23, wherein said spike driving system comprises:

a spike driving system support structure having a first end and a second end;
an actuator coupled to said first end of said spike system support structure and configured to position said second end of said spike system support structure in response to control signals from said controller;

a spike magazine configured to hold a plurality of spikes coupled to said spike system support structure;

a spike receiver configured to aim a spike downward and coupled to said second end of said spike system support structure and configured to receive a spike from said spike magazine; and

a spike driver coupled to said spike receiver and said spike system support structure;

whereby, in response to control signals from said controller, said actuator positions said second end of said spike system support structure and said spike driver drives a spike downward through said spike receiver and into the ground.

27. (withdrawn): An apparatus as recited in claim 23, further comprising:
an articulating arm assembly having a first end and a second end;

said first end of said articulating arm assembly coupled to said support structure and configured to articulate said second end of said articulating arm assembly horizontally; and

an articulating arm actuator cooperating with said support structure and with said first end of said articulating arm assembly to position said second end of said articulating arm assembly at a vertical position of said underground utility in response to control signals from said controller;

whereby said paint spraying system and said spike driving system respond to control signals from said controller by marking the located position of said underground utility.

28. (original): An underground utility symbol painting apparatus comprising:
a support structure configured to maneuver along a proximate path of an underground utility;

a controller configured to generate control signals;

a painting system support structure with a first end and a second end;

said first end of said painting system support structure configured to be coupled to said support structure;

a painting system support shaft oriented horizontally and coupled to said second end of said painting support structure;

an actuator coupled to said painting system support structure and configured to position said painting system support structure in response to control signals from said controller;

a contact wheel assembly oriented vertically and coupled to said painting system support shaft and configured to rotate on said painting support shaft;

a drum template coupled to said contact wheel assembly; and,

a paint dispenser coupled to said painting support shaft;

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whereby, in response to control signals from said controller, said actuator positions said painting system support structure until said contact wheel contacts a surface, said contact wheel rotates said drum template, and said paint dispenser dispenses paint through said drum template onto said surface to apply a symbol.

29. (original): An apparatus as recited in claim 28, further comprising an underground utility detector coupled to said support structure that generates a positional signal relative to a vertical position above an underground utility.

30. (withdrawn): An underground utility spike marking apparatus comprising:
a support structure configured to maneuver along a proximate path of an underground utility;

a controller configured to generate control signals;
a spike system support structure having a first end and a second end, said first end configured to be coupled to said support structure;
a spike system support actuator coupled to said first end of said spike system support structure and configured to position said spike system support structure in response to control signals from said controller;
a spike receiver oriented to drive a spike downward;
said spike receiver coupled to said second end of said spike system support structure and configured to receive a spike; and
a spike driver associated with said spike receiver and said spike system support structure;
whereby, in response to control signals from said controller, said actuator positions said spike driving support structure and said spike driver drives a spike downward through said spike receiver.

31. (withdrawn): An apparatus as recited in claim 30, further comprising an underground utility detector coupled to said support structure and configured to generate a positional signal relative to a vertical position above an underground utility.

32. (withdrawn): An underground utility locating and marking apparatus comprising:

a chassis configured to maneuver along a proximate path of an underground utility;

a carriage coupled to said chassis to move horizontally and laterally to the direction of movement of said chassis;

an underground utility detector coupled to said carriage and that produces a positional signal relative to a vertical position above an underground utility;

a controller configured to receive positional signals from said underground utility detector and generate control signals;

a carriage actuator cooperating with said chassis and with said carriage to position said carriage at a vertical position of an underground utility in response to control signals from said controller;

a painting system support structure with a first end and a second end;

a painting system support shaft oriented horizontally and coupled to said second end of said painting system support structure;

a painting system actuator coupled to said painting support structure and configured to position said second end of said painting support structure in response to control signals from said controller;

a contact wheel assembly oriented vertically and coupled to said painting support shaft and configured to rotate on said painting support shaft;

a drum template coupled to said contact wheel assembly; and

a paint dispenser coupled to said painting system support shaft configured to dispense paint downward through said drum template;

whereby, in response to control signals from said controller, said painting system actuator positions said second end of said painting system support structure until said contact wheel contacts a surface, then said contact wheel rotates said drum template and said paint dispenser dispenses paint through said drum template onto said surface to apply a symbol;

a spike system support structure with a first end and a second end, said first end configured to align with said carriage;

a spike system support actuator coupled to said first end of said spike system support structure and configured to position said second end of said spike system support structure in response to control signals from said controller means;

a spike magazine configured to hold a plurality of spikes coupled to said spike system support structure;

a spike receiver configured to aim a spike downward and coupled to said second end of said spike system support structure and configured with said spike magazine to receive a spike from said spike magazine; and

a spike driver coupled to said spike receiver and said spike system support structure;

whereby, in response to control signals from said controller, said spike system support actuator positions said second end of said spike system support structure and said spike driver drives a spike downward through said spike receiver and into the ground.

33. (withdrawn): A method of locating and marking the surface position of an underground utility comprising the steps of:

providing a locating and marking apparatus comprising, a support structure, means for detecting a location of an underground utility, means for indicating a position proximate vertical of an underground utility, and means for making a proximate vertical surface position of an underground utility;

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providing motion to said apparatus along a general path an underground utility;
automatically positioning said means for marking proximate vertical of an
underground utility with said means for positioning and in response to positional signals
from said means for detecting; and

marking the surface position proximate vertical of an underground utility with said
means for marking.